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ABSTRACT

This paper reports on overall accomplishments in meeting goals for technology infusion at California Lutheran University's School of Education, using evaluation data collected over 3 years. Data came from surveys completed by administrators, faculty, and students about their experiences using technology at baseline (1997) and over the next 3 years. Results indicated that students used e-mail often, and this use increased dramatically over the study period. Word processing as a tool also increased over time. The use of database applications, spreadsheets, and word processing slowly increased as a course requirement over time. Students' beliefs that more technology was needed in the School of Education declined over time, as did their beliefs that the use of video recorders and videotapes helped in understanding course material and that distance learning enhanced the learning experience. The overall analysis indicated that the use of technology was being integrated at a rate that was comfortable for most students, and that students were less likely to feel that more technology was needed in teaching and learning in the School of Education. (Contains 16 figures and 35 references.) (SM)

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Infusing Technology Throughout Teacher Education

Susanne Maliski, Carol Bartell, and Paul Gathercoal

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Infusing Technology Throughout Teacher Education

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Introduction

There is an increasing expectation that today's teachers will be able to use instructional technology in their classrooms. Factors fueling this expectation include: (1) the need to provide relevant and authentic instruction that reflects contemporary and future social and economic demands on students (Thornburg, 1992); (2) the compatibility of certain computer-based technologies with newer, research-based approaches to teaching and learning (Bracey, 1993; Campoy, 1992; Kent & McNergney; 1998; Sheingold, 1991; Thornburg, 1992); (3) student and parent expectations (Topp, Mortensen, & Grandgenett, 1995); and (4) guidelines and mandates from federal, state, district, and professional bodies (NCATE, 1997; Ramirez & Bell, 1994; Thomas, 1994; Widmer & Amburgey, 1994).

Nationally, Schools of Education are making progress in the use of both basic and interactive technologies in teacher education programs (Persichitte, Tharp, & Cafferela, 1997). However, a U.S. Congress, Office of Technology Assessment (OTA) report found that technology was not central to instruction for teachers, and that "most technology instruction…is teaching about technology…not teaching with technology across the curriculum" (1995, p. 165).

Pellegrino and Altman (1997) describe what is needed to accomplish this across-the-curriculum model of technology infusion. They advocate a plan which includes: 1) moving students from consumers and participant observers of technology-based learning applications to producers of content applications appropriate for their own teaching; 2) shifting of technology applications from supplementary to central in a given course's learning activities; 3) a gradual and progressive increase in the sophistication and complexity of the technology-based applications that students experience in a course.

Barriers to expanding the use of technology among prospective teachers are identified as: 1) limited availability of equipment; 2) lack of faculty training; 3) no clear expectation that faculty will incorporate technology in academic activities; 4) lack of funds; 5) lack of time to develop facility in using equipment and software; 6) doubt about the pedagogical validity of using some of the newer technologies since the appearance of literature about these tools is relatively recent; 7) lack of

technical support; 8) lack of appropriate materials, particularly integrated media materials suitable for teacher education instruction; and 9) absence of clear programmatic goals for the teacher education program as a whole (Topp et al, 1995; Baron and Goldman, 1995).

We know that preservice teachers learn about the appropriate use of technology in the classroom when they are provided with models of good practice (Sandholtz, Ringstaff & Dwyer 1997). They cannot learn to teach with technology unless they see instructional technology used effectively.

We can teach about effective technology use, but preservice teachers need to see effective uses of technology resources when they engage in field experiences in actual school settings. Teachers need to use technology in their own learning, but need to learn to use technology effectively in their own classrooms with their own students (Quiñones & Kirshstein, 1998).

Technology offers promise as a tool and a resource for those of us who prepare teachers, and for teachers themselves who are challenged to provide more and better services and educational opportunities for students. It challenges us to think about new ways to link our students, our faculty, our educational partners, and our wider communities together to expand, improve, develop, and enhance the learning experience for all. It is this challenge that has led us to conceive a plan for utilizing technology in ways that would support and enhance our programs at California Lutheran University and help better prepare our teacher candidates to become educational leaders for a technology-rich world.

Technology Infusion at California Lutheran University

When we embarked on our technology-infusion efforts at California Lutheran University in 1998, California Lutheran University had already committed significant resources to developing our technology capabilities. Many faculty were using technology in ways that were comfortable and useful to them. In the beginning of the three year period, School of Education faculty members were using technology to deliver and enhance instructional opportunities, conduct research, and communicate with students outside of class. However, this use was highly idiosyncratic, largely dependent upon the interests and inclinations of the individual faculty member, course specific, and not well connected to any overall programmatic vision or initiatives. We were poised to take the next step to fully integrate technology into our program and to utilize its power to significantly change the way we prepare teachers for their work in contemporary schools.

The School of Education included in its own strategic plan the goal of infusing technology in every program. We were assisted in our efforts to infuse technology through the award of a 3-year grant from the U. S. Department of Education, Office of Post Secondary Education under the "Preparing Tomorrow's Teachers to Use Technology" (PT3) program. The grant has provided needed resources to help us achieve our already agreed upon goals for the School, and, more specifically, for teacher education.

Our PT3 Project was entitled: MAGNETIC CONNECTIONS, a label that symbolizes the drawing together of people and resources needed to accomplish technology infusion in our programs. Teacher education does not occur in isolated classrooms that are disconnected from practice. We believe that making, building, and strengthening connections are vital to the future of teacher education. CONNECTIONS between content and pedagogy, CONNECTIONS between theory and practice, CONNECTIONS across the curriculum, CONNECTIONS between the university and the schools, and CONNECTIONS between teachers and students are only some of the most crucial linkages that must be made. Technology holds promise of being a tool and a resource for making these CONNECTIONS.

There is a natural affinity and powerful draw among the participants in this project; they have common goals and purposes to improve teaching and learning for all. They have already committed to the use of technology as a vehicle for improved instruction. These common purposes serve as a MAGNET, drawing together all of the players and the resources they bring to the table. In this project, a primary resource for linking with the real world of practice are three MAGNET schools—schools with a special focus on technology. Therefore, we entitled our PT3 funded Project MAGNETIC CONNECTIONS, anticipating that we would take advantage of this natural affinity to strengthen these powerful connections through the use of technology.

When we began our work, the School of Education offered courses each semester for preservice teachers seeking to satisfy the State's "computer education" requirement. These courses had already been enhanced to meet the new computer education standards set by the California Commission on Teacher Credentialing (CCTC). However, we felt that these new standards and our own expectations would not be fully realized by preservice teachers if they were only addressed within the context of one or two courses. The use of technology in teaching and learning needed to be modeled and reinforced throughout the teacher preparation program by all faculty teaching in the School of Education.

Our efforts have been designed to build the capacity of CLU faculty, consortium teachers, and university supervisors to model the appropriate selection, access and use of technology in teaching and learning and to mentor preservice teachers about, with, and through technology.

The overall goal of our infusion efforts represented in MAGENETIC CONEECTIONS was to better prepare preservice teachers for teaching and learning in the 21st century. To accomplish this overall goal, we established the following intermediate goals:

- To develop in higher education faculty, master teachers in K-12 schools, and university supervisors the ability to be better mentors and models for preservice teachers, who integrate and appropriately use technology in their own teaching and learning
- To expand the Teacher Preparation Program and reach more preservice teachers.
- To develop and use new assessment models that incorporate the use of an electronic portfolio system.
- To build better linkage between higher education undergraduate, graduate, and K-12 schools
- To contribute to the research base on preservice teacher preparation.

While the overall goals for the project contribute and lead to a full infusion of technology in teacher education, the focus of this paper is on the specific progress made to increase technology use among faculty and students in our program. Other papers in this series report on our overall accomplishments in meeting the specific goals established for the project. This paper reports on our progress in meeting our goals for technology infusion, using evaluation data collected over the last three years.

Technology and Institutional Culture

Sandholtz, Ringstaff & Dwyer (1997) indicate faculty will not use technology unless they **believe** it will make a difference in the quality of education provided their students. Addressing faculty beliefs is number one on the list of imperatives for infusing technology throughout the program.

The use of technology irreversibly changes the faculty members' role and the role of the student. No longer is the student simply the recipient of information; the student is actively involved in constructing meaning by generating and displaying real world responses to questions and assignments that arise in a courses or programs of study. The faculty member no longer simply

imparts information, but helps the student to construct meaning through facilitating and coordinating the learning environment, using technology. The use of technology provides many opportunities for authentic assessment and it matches well with methods and strategies that complement constructivist philosophies.

Technology allows for creative thinking and collaboration with others. Students are not confined by the limitations of texts and paper and pencil. Students have all the resources of the WWW available to them and they can confer and collaborate with anyone else in the world. Students can display graphics, sound, digital video, text and use other presentation media to display and communicate what they know and learned. The possibilities are virtually limitless, only limited by the student's imagination.

An information campaign aimed at elucidating the educational and practical benefits of using technology in teaching and learning is needed. And, at the same time, there needs to be an "implementing force" driving faculty to simply consider the proposition that using technology in teaching and learning will improve the quality of instruction throughout the program (Gathercoal, 1991). An "implementing force" can be an idea, a policy, resources or some other motivating factor that encourages faculty to consider the possibilities and to imagine the use of technology in teaching and learning. Usually, affecting faculty beliefs will go hand-in-glove with establishing an "implementing force," but this need not always be the case.

California Lutheran University's School of Education had several implementing forces driving faculty to consider the possibilities for using technology in teaching and learning. First, the administration's rhetoric and policy statements encouraged the use of technology by faculty and students. The administration's communications with faculty were backed by State and National standards advocating the use of technology throughout the educational program. Second, a Director of Educational Technology was hired with the mission to infuse technology throughout the School of Education. This person assisted faculty one-on-one, conducted workshops for faculty and students and advocated for resources to assist with infusing technology throughout the school. Third, the technology leaders in the School of Education developed a successful "Preparing Tomorrow's Teachers to Use Technology" (PT3) grant from the U.S. Department of Education. Prior to submitting the grant, however, the authors took its contents to the faculty and presented all goals and objectives of the grant for faculty approval. Each goal was read and displayed and every faculty member was asked whether he or she could live with the goal or objective or whether it needed changing. This tacit approval from faculty and concomitant grant award provided the School of Education with a powerful "implementing force" and belief system that the infusion of technology would work to benefit the education of all students.

Faculty beliefs need to be addressed first and they need to be addressed often. The infusion process cannot address faculty beliefs once and think that it is finished. Faculty will question the use of technology every step of the way. Those responsible for the implementation must be knowledgeable of reasons why technology is good for education and how it works in the best interests of the students.

The initial "implementing forces" and "adaptations" of faculty beliefs were short-lived in the School of Education. Beginning the second year of PT3 grant initiatives, faculty again raised the question, "What evidence do we have that technology is enhancing the teaching and learning of our students?" This question was addressed at the first technology-training meeting of faculty and information regarding the benefits of the infusion of technology into teaching and learning was provided. Faculty seemed to once again come to terms with their beliefs and endeavored to infuse technology throughout the program for the next two years.

Infusion of Technology throughout the School of Education

During the fall semester of 2001 administration, faculty, and students in the School of Education at California Lutheran University completed a survey about their experiences with the use of technology in teaching and learning at California Lutheran University. The students were administered a 16-item self report survey. The students were asked to rate their experience and share their opinions about different forms of technology that may or may not have been used in their courses at California Lutheran University and to what extent their experience influenced their learning overall. Faculty and administration were interviewed in person, through telephone conversations, through e-mail, or TappedIn, an online conference website. Faculty were asked five open-ended questions to ascertain their use of technology in and out of the classroom, their sense of their own progress with technology over the past three years, and future goals related to technology in teaching and learning.

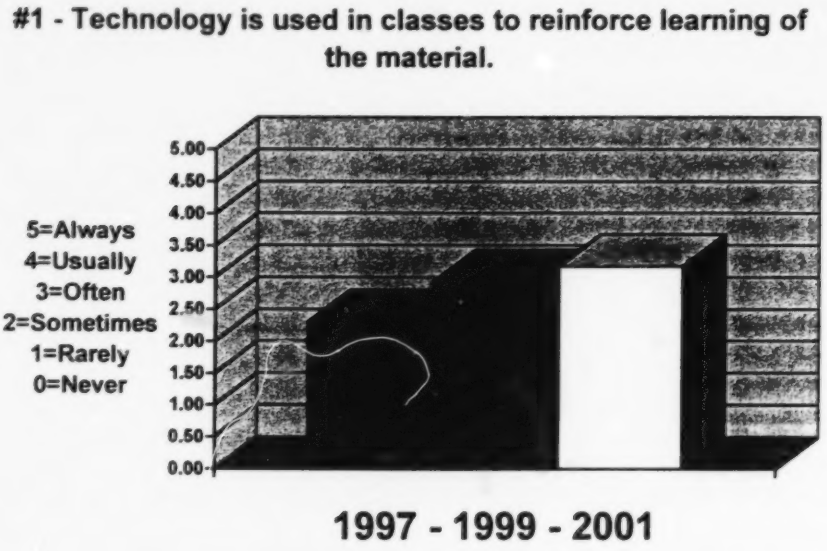
Results were compared to the baseline data that was established in 1997 and 1999. This is the third time faculty, administration, and students participated in surveys of this nature. The student survey consisted of the original twelve questions from 1997 and 1999 questionnaires and added four new questions to address new trends in technology and teaching and learning. The guiding questions behind this inquiry remain:

1. Has the School of Education increased its effective use of technology in teaching and learning?
2. Concerning the use of computer-based technology is the School of Education progressing in an efficient and educationally sound manner?

Comparison of Student Surveys

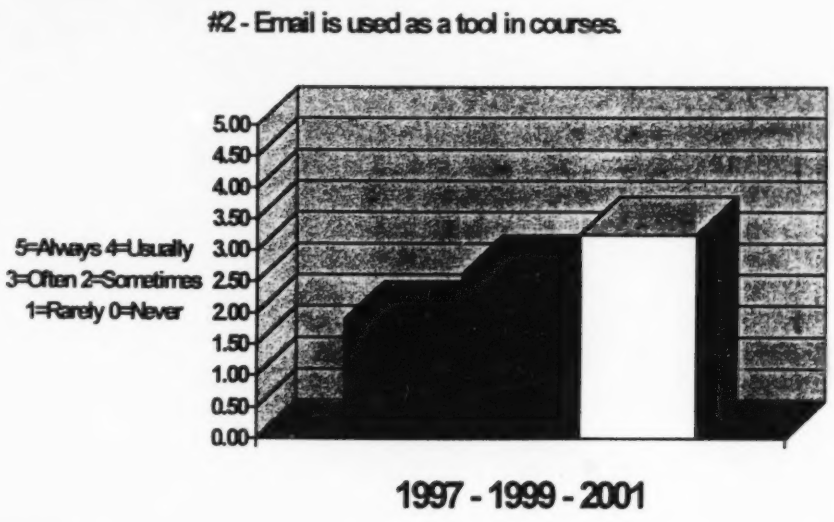
Students who enrolled in at least one class in the School of Education during the Fall of 2001 at the end of the semester completed a survey. This information was compared to the information collected in 1997 and 1999 for the first twelve questions. For the last four questions the information has been used to establish baseline data for future studies, as well as, to note changes in technology trends that have developed over the last three years. These responses reflect students' opinions and experiences at California Lutheran University. In addition students were asked to identify their gender, age, program of study, and number of classes taken. There were 302 respondents in 1997, 346 respondents in 1999, and 512 respondents in 2001. The information was calculated and the means are graphed below for each question for each year. Graphs show students' mean responses for 1997, 1999, and 2001.

Figure 1. School of Education students' mean response to question #1.



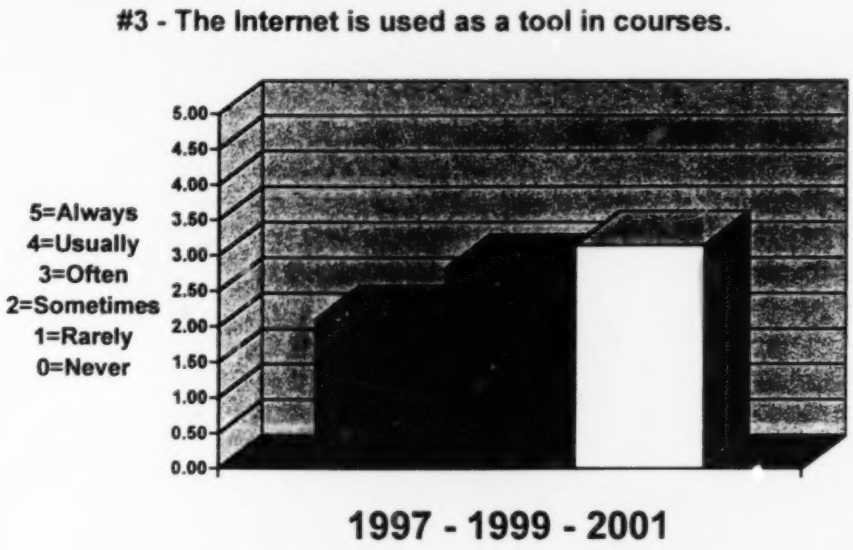
■ Fall 97 Mean	2.3
■ Spring 99 Mean	2.93
□ Fall 01 Mean	3.17

Figure 2. School of Education students' mean response to question #2.



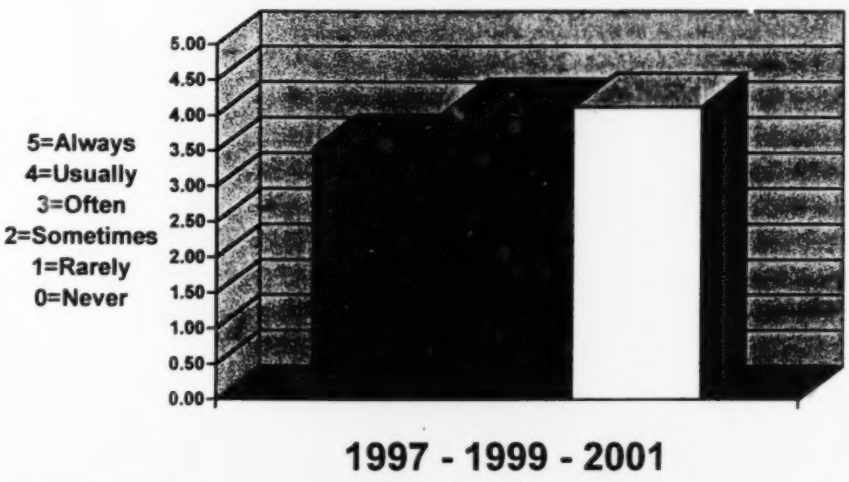
■ Fall 97 Mean	1.89
■ Spring 99 Mean	2.62
□ Fall 01 Mean	3.24

Figure 3. School of Education students' mean response to question #3.



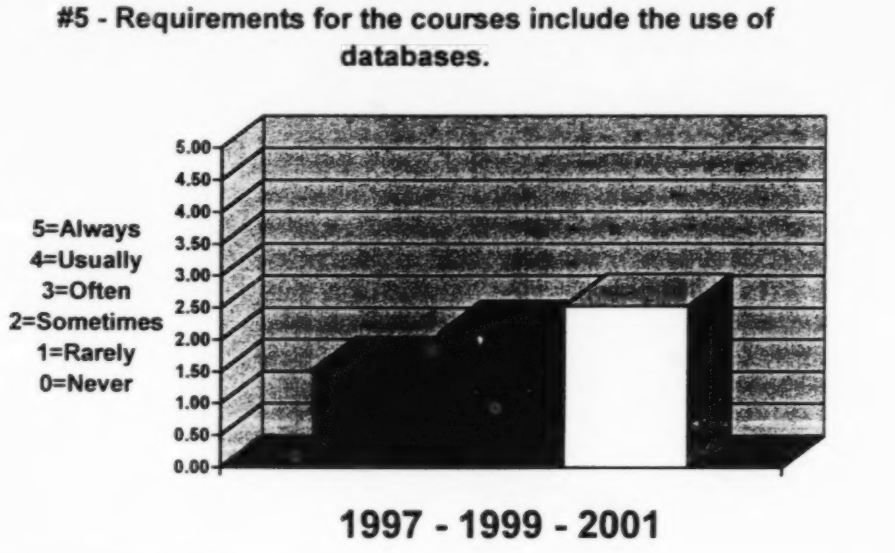
■ Fall 97 Mean	2.1
■ Spring 99 Mean	2.82
□ Fall 01 Mean	3.15

Figure 4. School of Education students' mean response to question #4.



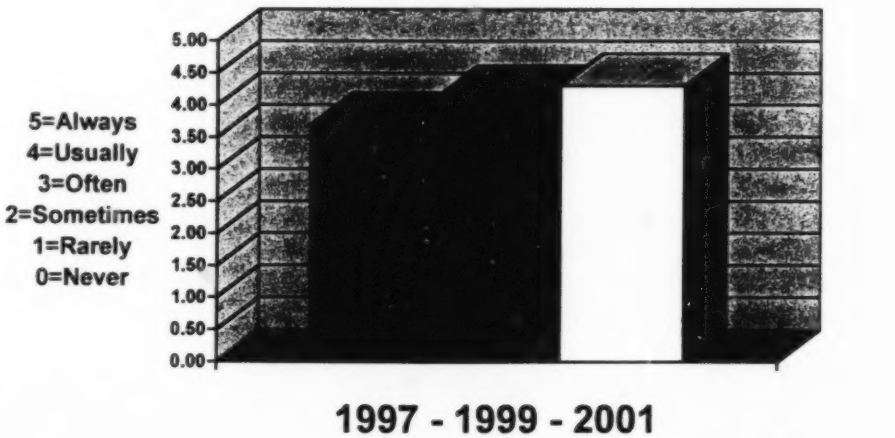
■ Fall 97 Mean	3.54
■ Spring 99 Mean	4.04
□ Fall 01 Mean	4.12

Figure 5. School of Education students' mean response to question #5.



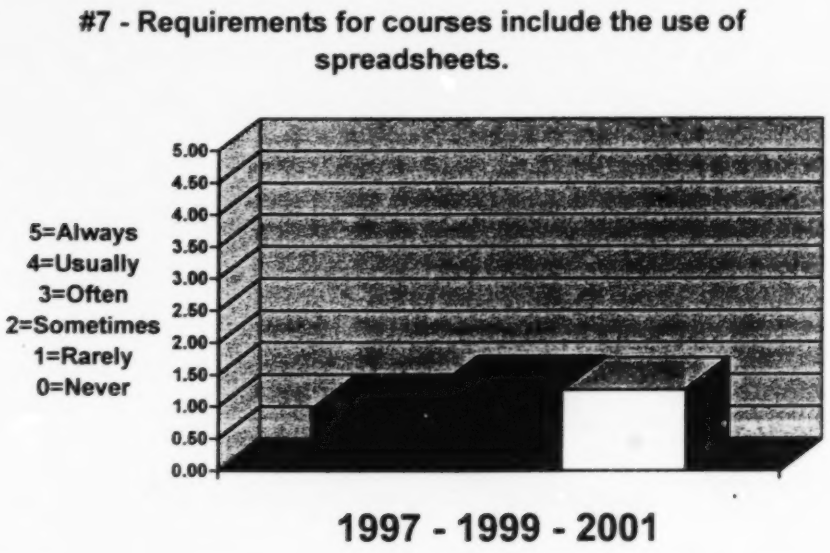
Fall 97 Mean	1.54
Spring 99 Mean	2.1
Fall 01 Mean	2.53

Figure 6. School of Education students' mean response to question #6.



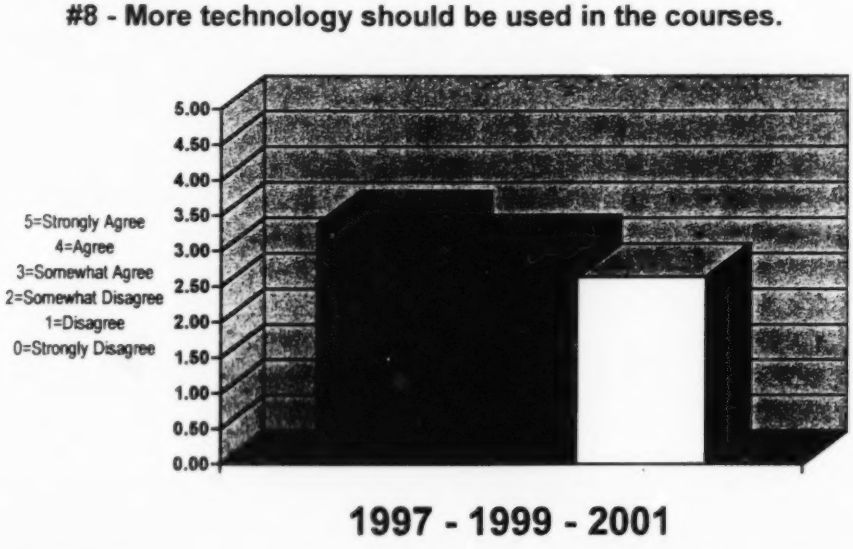
Fall 97 Mean	3.69
Spring 99 Mean	4.11
Fall 01 Mean	4.3

Figure 7. School of Education students' mean response to question #7.



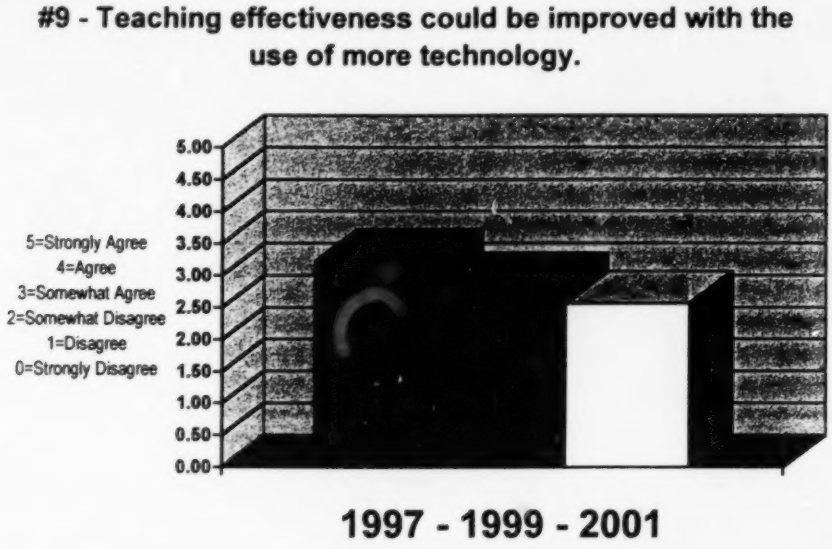
■ Fall 97 Mean	0.96
■ Spring 99 Mean	1.29
□ Fall 01 Mean	1.26

Figure 8. School of Education students' mean response to question #8.



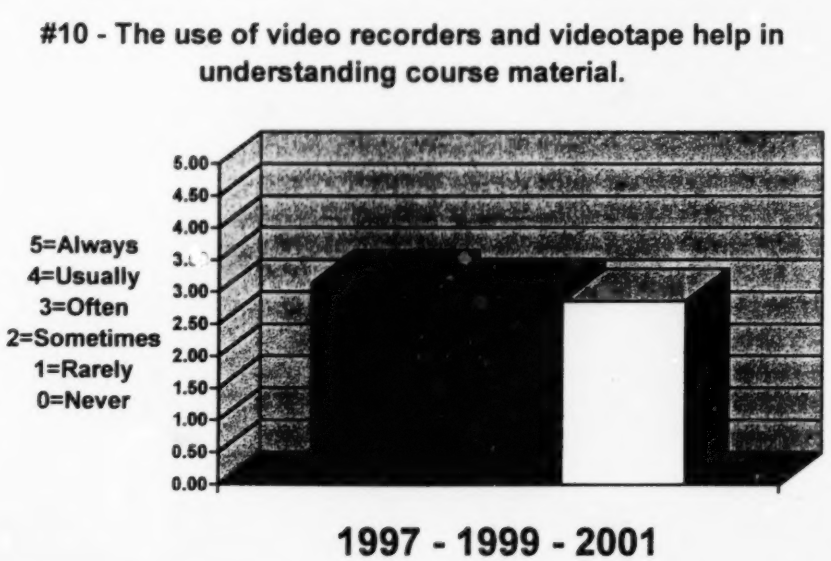
■ Fall 97 Mean	3.38
■ Spring 99 Mean	3.04
□ Fall 01 Mean	2.64

Figure 9. School of Education students' mean response to question #9.



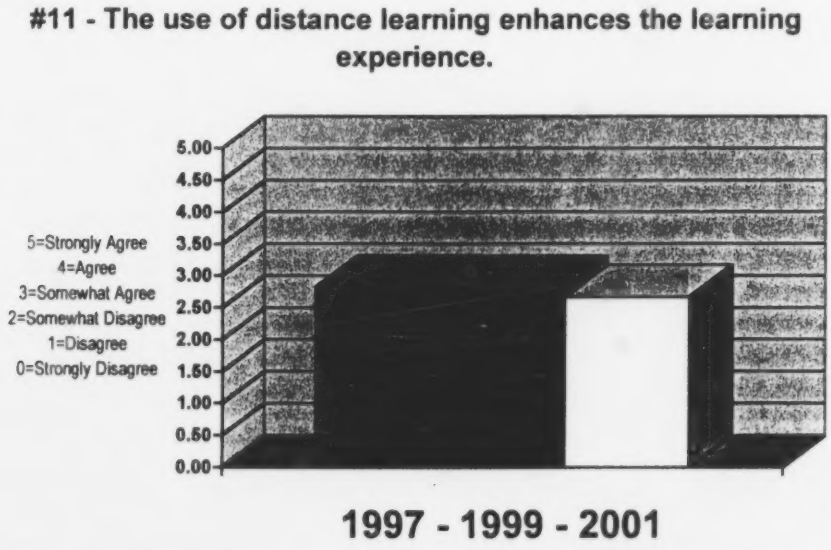
■ Fall 97 Mean	3.22
■ Spring 99 Mean	2.85
□ Fall 01 Mean	2.56

Figure 10. School of Education students' mean response to question #10.



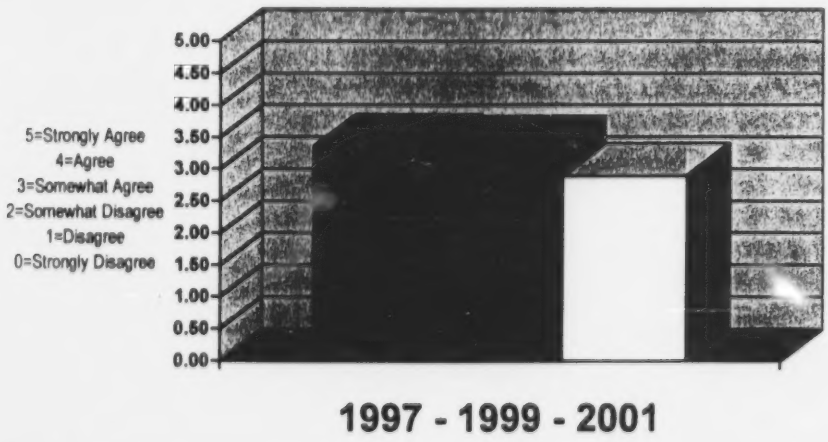
■ Fall 97 Mean	3.14
■ Spring 99 Mean	3.01
□ Fall 01 Mean	2.66

Figure 11. School of Education students' mean response to question #11.



■ Fall 97 Mean	2.82
■ Spring 99 Mean	2.81
□ Fall 01 Mean	2.67

Figure 12. School of Education students' mean response to question #12.



■ Fall 97 Mean	3.35
■ Spring 99 Mean	3.32
□ Fall 01 Mean	2.9

Figure 13. School of Education students' mean response to question #13.

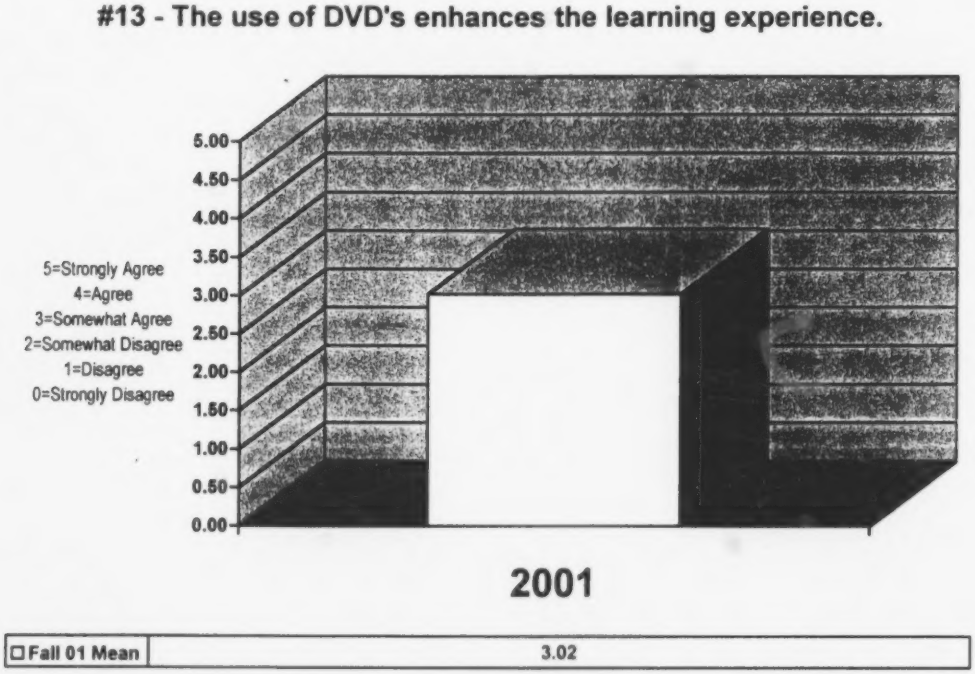


Figure 14. School of Education students' mean response to question #14.

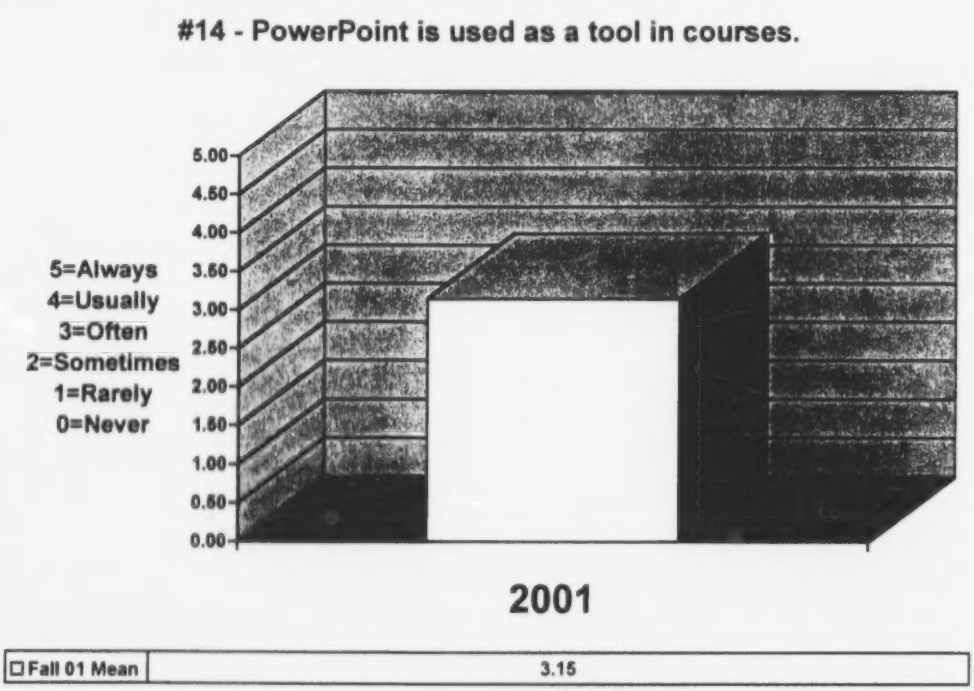


Figure 15. School of Education students' mean response to question #15.

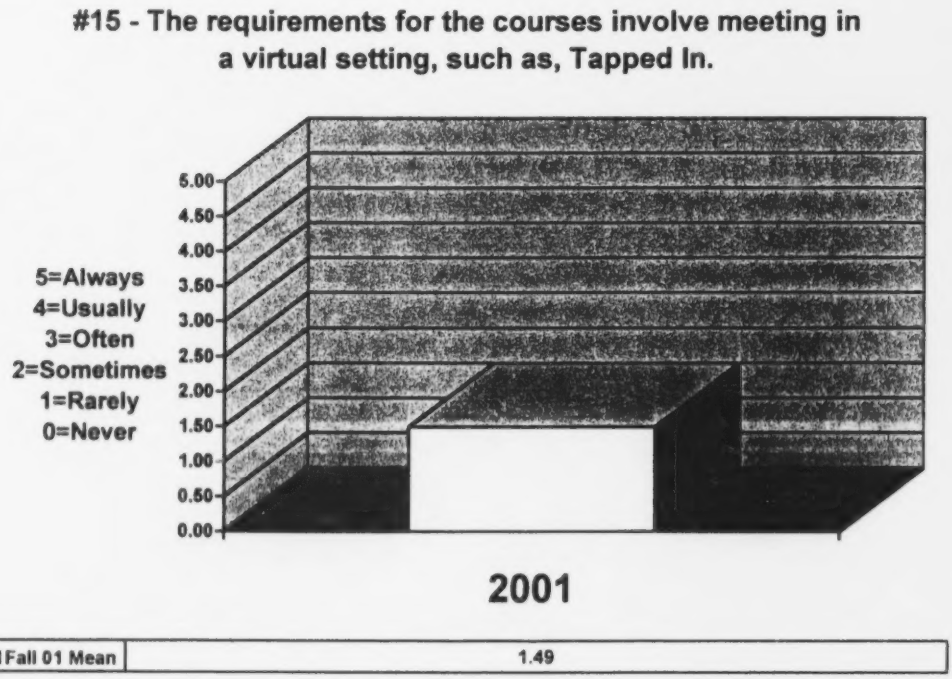
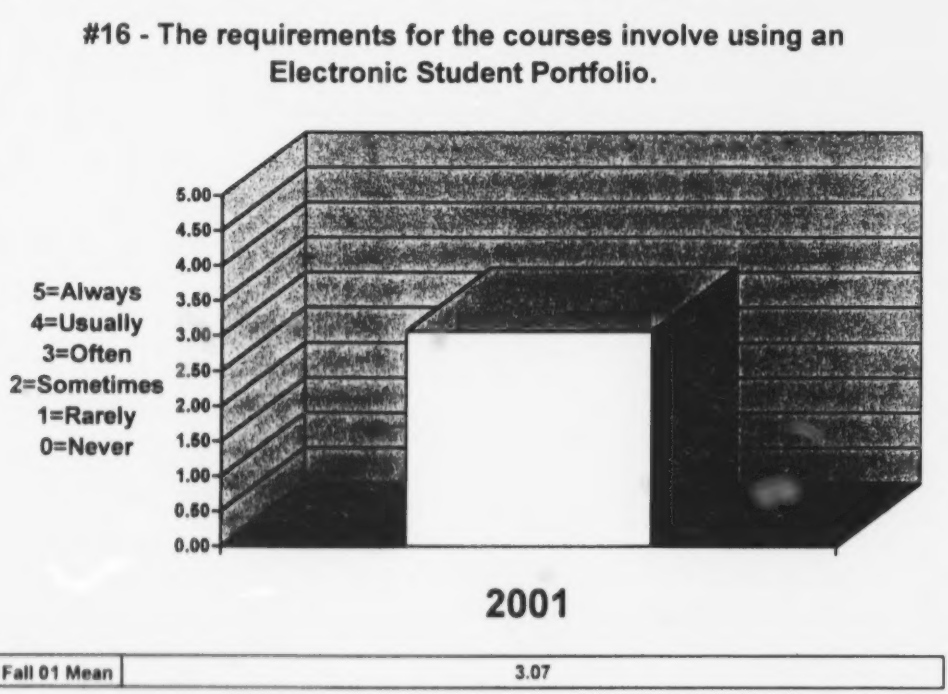


Figure 16. School of Education students' mean response to question #16.



Analysis of Student Responses

The students' responses were collected and analyzed using SPSS. The means were calculated using SPSS and added to an Excel spreadsheet. The results are displayed graphically, above. The analysis is based upon calculated means of students' responses during the 1997, 1999, and 2001 surveys.

Students' responses for questions one through seven asked about students' experience with technology in their classes. The students ranked their answers on a likert scale of five choices, five being the highest and zero being the lowest. Five was "Always," four was "Usually," three was "Often," two was "Sometimes," one was "Rarely," and zero was "Never." The mean for students' responses to these questions continues on an upward trend from 1997 to the 2001 survey. Overall, students indicate that technology is being used "Often" in their classes, which increased from their ranking that technology was used "Sometimes" in 1997 and 1999.

The results of analyses of specific technologies show that e-mail is used "Often." This has increased drastically from 1997. In 1997 students ranked it as being used "Rarely." In 1999 students ranked it as being used "Sometimes." The use of the Internet in courses has increased. In 1997 and 1999 students ranked it as being used "Sometimes" and in 2001 students ranked it as being used "Often." Word processing as a tool has also increased since 1997. It has gone from being used "Often" to being used "Usually" in 1999 and 2001.

Other questions asked students about requirements for their classes. The same scale was used for these questions as described above. The uses of database applications are slowly increasing as requirements in courses. Students ranked databases, as being required "Rarely" in 1997 and being required "Sometimes" in 1999 and 2001. Requirements for the use of word processing have also continued to increase. In 1999 students said word processing was being required "Often" and in 1999 and 2001 students said it was being required "Usually." The required use of spreadsheets has increased slowly. In 1997 students ranked spreadsheets as being used just under 1, which is the "Rarely" level. In 1999 and 2001 the rating was just over 1, ranking them, as being required "Rarely." Another tool that has been added to the survey for 2001 is PowerPoint. This tool was ranked as being required "Often" in courses.

Still other questions asked students to rank their opinions about the need for more technology in teaching and learning. A likert scale was used with five for "Strongly agree," four for "Agree," three for "Somewhat Agree," two for "Somewhat Disagree," one for "Disagree," and zero for "Strongly Disagree." The results of these questions indicate that students are feeling less and less that more technology is needed in the School of Education. The level has decreased from "Somewhat Agree" with the need for more technology in 1997 and 1999 to "Somewhat Disagree." Responses to question 9, which asked if teaching effectiveness could be improved with the use of more technology, also support the idea that students are feeling that teachers do not need to use more technology than they are already using. In 1997 students indicated that they "Somewhat Agree" with the statement that teaching effectiveness could be improved with the use of more technology. In 1999 and 2001 responses decreased to "Somewhat Disagree" and moved toward "Disagree" in terms of more technology needing to be used to improve teaching effectiveness.

Students were asked if the use of video recorders and videotapes help in understanding course material. The students' responses have decreased in this area. In 1997 students said that videotapes "Often" helped in understanding. This response maintained at the "Often" level, but moved toward the "Sometimes" level in 1999. In 2001 the response decreased to the "Sometimes" level. The mean of students' responses to question 10 has decreased over the last three surveys. The students ranked the use of videodisc as enhancing the learning level at the "Somewhat Agree"

level in 1997 and1999, but in 2001 students response level dropped to the "Somewhat Disagree" level. Related to question 12, question 13 asked, "The use of DVD's enhances the learning experience." This question was not included in the 1997 and 1999 surveys, but in 2001 students indicated that they "Somewhat Agree" with that statement. This suggests that the trend may be developing in technology use that is moving away from videotapes and videodiscs and moving toward the newer technology of DVD's.

Students' response level to the statement "The use of distance learning enhances the learning experience" has continued to decrease gradually. From 1997 to 1999 the response stayed constant at "Somewhat Disagree." In 2001 the response level decreased, but stayed within the "Somewhat Disagree" range. Related to distance learning a new question was added to the survey in 2001 asking if requirements for the class involved meeting in a virtual setting. The student responses rated this in the middle of the "Rarely" range. Question 16 is also related to distance learning and it asks if students' courses required the use of an electronic student portfolio. The students indicated that they were "Often" required to use and electronic portfolio

The overall analysis indicates that the use of technology is being integrated at a rate that is comfortable for most students and they are less likely to feel that more technology is needed in teaching and learning in the School of Education. The key will be to continue this pattern and find new ways to use technology. These responses show how quickly technology trends change and how important it is to keep up to date on technology. It will be important to keep using the tools that have been developed, while taking advantage of tools that are being neglected, such as, spreadsheets and distance learning.

When infusing technology throughout the program, it is important not to try and do everything at once. While maintaining faculty beliefs that technology will make a positive difference and establishing more "implementing forces," the next step is to break the infusion process down into incremental units. We found that it is best to start small and then expand to other parts of the program using the more successful strategies and technologies. We also discovered that the infusion of technology throughout the program takes time, possibly several years.

Resource allocation and reallocation are critical to the infusion process. The implementation process will need institutional backing and credentials. The administration needs to "anoint" the process and its people and ensure that all who are involved know that the implementation process is "approved." Although the process has many "champions," including the Dean, the chairs of the departments, and dedicated faculty, it helps to give the process a name. At California Lutheran University, the process is called, "MAGNETIC CONNECTIONS" and the "newly named" process champions are called "Director," "Clinical Faculty," "Curriculum Coordinator" and "Open Lab Assistant." When the infusion process and its people are given titles and recognized by the institution, the process finds a quick way of explaining away things that may not make sense. For example, when it is announced that the Clinical Faculty will be team-teaching with Teacher Preparation Department faculty, there are few questions asked about why or what. Simply mentioning the name Clinical Faculty brings back visions of a commitment made to the infusion process.

Successful infusion of technology demands regular meetings be held to provide faculty with the concepts and skills for successful implementation. All faculty need to attend these professional development meetings, and there must be multiple sessions to accommodate the varied schedules of faculty. The meetings should address both theory and practice. The meetings should be held during regular teaching hours and the faculty should be paid to attend. At California Lutheran University consultants come in twice a year to conduct intensive training in the use of a webfolio system. As well, technology workshops and curriculum revision meetings are held throughout the year. Faculty

participated in an average of 31 hours of professional development meetings and they are paid for their time and their work on infusing technology into teaching and learning.

Respecting students' and faculties' needs and their different learning styles and the speed with which they come to terms with technology in teaching and learning need to be taken into consideration and valued. For example, some faculty and students have simply been "pushed out" of the program because they could not come to terms with the use of technology. It will always be an open question whether their leaving the program was a good thing, or whether the technology should have had less importance. Holding a strict posture on these issues will certainly affect the culture of the institution and "push" some faculty and students out of education forever. California Lutheran University's School of Education is taking a mentoring posture and helping faculty and students to come to terms with the new situation.

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